KNOWLEDGE MANAGEMENT

KNOWLEDGE MANAGEMENT SOFTWARE APPLICATION IN ICE-CREAM COMPANIES

Ana Ristevska
Faculty of economics – Prilep, email: ana.ristevska12@gmail.com

Abstract : *In this paper will be explained the meaning of knowledge management software application and the importance of using this kind of software applications in companies. Also in this paper will be listed types of knowledge management software applications that can be used in the companies. In this part will be given some facts from the ice-cream industry and will be mentioned possibilities for using knowledge management software in this industry. After the theoretical explanation of knowledge management software applications, the practical research in this paper will be done in the biggest ice-cream company in the Republic of Macedonia. In this part will be explained why ice-cream companies should use knowledge management software application and what kind of benefits the companies can get by using this application. The aim of this paper is to contribute for raising the awareness of ice-cream companies to use this kind of software application through the example of the biggest and the most successful ice-cream company in the Republic of Macedonia.*

Key words: knowledge management software application, ice-cream company

1. KNOWLEDGE MANAGEMENT SOFTWARE APPLICATIONS

1.1. Definition and meaning of knowledge management software applications

Nowadays more and more companies are turning to modern and advanced operations. All working processes in companies are increasingly computerized in order to obtain faster, simpler and accurate execution of all work activities. In addition to work activities, companies start to computerize also the knowledge that they possess. This can be done by using the appropriate software that helps companies to use effectively their intellectual capital. The knowledge management software applications need to distribute and maintain knowledge of the company. The basic principle of knowledge management software applications is to disseminate knowledge in appropriate and easy to use format to the appropriate person and appropriate place in order companies to be competitive on the market and to have effective execution of all tasks.

The knowledge management software application is not a software application with standard size, shape and look. In fact, knowledge management software applications can be very different from one company to another. This is because of the different activities of the companies and different intellectual capital owned by each company. But whatever the differentiations between the companies, we can say that knowledge management software application in the companies can support generation, storage, update and distribution of knowledge.

The company's ability to learn and change, and more importantly to learn faster than other companies and to turn learned things into action, is the greatest power of a company. (Mašić and Đorđević, 2008). With the help of software knowledge management, company will be able to make changes in order to transfer knowledge and to improve processes, develop new products or services in order to meet the needs of customers, attract new customers and achieve all the company's goals.

Companies that want to use the knowledge management software need to know what goals want to achieve by using this kind of software. If companies start to use the knowledge management software that means these companies realized how precious are intellectual capital and knowledge which they possess.

The future of knowledge management software applications can be clearly predicted. As companies move into the age of knowledge, the need for proper software tools is increasingly growing because those tools will help companies to sort big quantities of data and information. Companies are inundated with e- mails, electronic newsletters, articles, graphs, customers' requests, prices etc. Regarding this issues companies spend a lot of time in sorting, filtering, answering and managing of all the things listed. (Kurucz, 2003). To avoid all this, companies should have a software solution that can properly handle with all electronic and written data, information, documents and knowledge and thus contribute companies to have constant progress and achieve their goals.

1.2. Types of the knowledge management software applications

Each company, depending on its business activity, can use different type of knowledge management software application. Knowledge management software application should fit and conform with the company's activities and tasks.
Companies can buy knowledge management software solution from software companies and also can order from them to create special software regarding their needs.
The most important goal of knowledge management software application is ensuring that data and information are collected and stored in proper way in order to be effective and efficient for use for the members of the company.
There are a variety of companies prepared to provide knowledge management solutions. Some of the leading providers are: Cobble Soft International Ltd, ePath Learning, Knowledge Powered Solutions, KANA Software, Inc., Overtone Software, Inmagic, Inc., LegalEdge Software, AHG, ICCM Solutions, Kanda Software, AccessData, Accusoft, Apple, ASG Software Solutions, Attensity, Brainware,Connotate, eTouch FTI Technology, Google, IBM, Oracle, Kana, Microsoft, K2, Kofax and many other software companies. Knowledge management has become increasingly important in a data-centric and service-focused economy. Regarding this the knowledge management software is also essential for company producers and service companies.

Knowledge management software can exist in many forms, including:

- Process-driven applications
- Automated data integration
- Data capture and workflow solutions
- Purpose-built databases
- Content life cycle management systems
- Automated document and classification solutions
- Document, content and imagine solutions
- Secure file sharing
- Optical character recognition
- Social analytics and engagement solutions
- Integration of enterprise search
- Business intelligence

Some of the already developed knowledge management software solutions are:[1]

- PHPKB (PHP Knowledge Base Software) is produced by PHP's leading knowledge management software bases, and offers assistance to companies through the support and management of their knowledge bases. PHPKB knowledge management software database provides statistical knowledge that is crucial for decision making in relation of existing and potential customers, and offers professional view using charts and diagrams that review all the information. The features of this software are especially suitable for companies that have a lot of information. With this software companies are able to process the information for potential customers and adjust their activities based on the processed information.

- SEM Knowledge Management software is produced by software company Kana and it is knowledge management software that allows access to all databases of the customers, as well as certain external databases of consumers made by another company or institution. This software can answer on demand estimated by the set of pre- entered contextual specifications. These specifications can be: setting value of the consumer, type of application, previous experience, number and type of the order etc.

- Safeharbor KMS is software developed by Safeharbor Knowledge Solutions. In the last decade, this software was used by more than 500 companies. It maximizes the management of knowledge in the company. Apart from storing data about potential customers, markets, prices, suppliers etc. this software offers several solutions, including: making assessments of the work, creating a strategy for attracting new customers, perform testing, analysis and compliance of information and creation of the best practices in the company in order for the company to meet the demands of the new customers and market.

- KBPublisher made by the same name manufacturer is a web-based software for managing knowledge. With this software companies can share the knowledge with other members and also they can publish and manage with articles, guidelines, processes, frequently asked questions and other information and items

[1] http://www.capterra.com/knowledge-management-software/

from the company. In order to use this knowledge based software, companies should have internet connection and web browser.

- Novo Knowledge Base Software is produced by software company Novo Solutions and this software allows quick and safe access to the entire knowledge of the company. This software is designed for companies that want to have a central repository of knowledge and all employees to have access on it. In this software has been implemented and training for employees.

- Archivd Research management knowledge software is produced by Archivd. Using this software, a company can collect and present all inquiries from potential customers that are made online. Furthermore they can easily be shared among the employees. This software is commonly used by production managers, sales managers and advertising agencies in order to process all the information obtained from the Internet for the new customers and to take actions that will contribute to satisfy their needs.

- Smart Support is produced by Safeharbor and it is software for knowledge management with main purpose to connect people with the proper answers. The software is intuitive, easy to integrate into web-based environment and offers advanced tools that can easily be managed and edited in knowledge base of the company. It should also be noted that this software offers templates for workflows, writing comments, documents etc. It is assumed that the return on investment of this software is in a period of six months or less.

- Akiva WebBoard Knowledge Base is produced by Aktiva and it is a software that collect and organize group information and content in the company. It has ability to collect, manage and query very large amounts of data, information, documents, photos and other contents. It performs fast and safe sharing of documents and verification of all data and information. Users can perform self-evaluation and management of content which are part of the company.

- Dezide Advisor is produces by Dezide and it is web based software that serves the employees and their existing and potential customers. If consumers have any questions or specific requirements, this software provides multiple solutions and answers of the questions. On this way customers get the most optimal answers in the shortest time.

- Traction Teampage is produced by Traction Software and it is software for knowledge management enabling seamless communication, collaborative work, quickly finding the data etc. This software allows monitoring of activities, discussions, collaboration between different sectors in the companies and control the execution of the employees' tasks.

- Column Case Management produced by Column Case Investigative is software that eliminates natural processes, increases efficiency, reduces errors, and thus the companies will be able to reduce costs and obtain better solutions. Through this software can be provided safe and secure management and sharing of information and processes, as well as cooperation between various sectors in the companies.

These and many other software solutions are developed and used by different kind of companies. Knowledge management software solutions are upgrading all the time in order to satisfy the needs and requests of the companies.

2. ICE-CREAM INDUSTRY AND USING OF KNOWLEDGE MANAGEMENT SOFTWARE APPLICATIONS

Ice-cream industry round the world takes great participation in global economy. The global retail ice cream industry revenue is estimated to reach $74 billion by 2018. Favorable demographic factors, rising consumer disposable income, and consumer's awareness toward frozen dessert mainly drive the demand. The retail ice cream industry includes retail sales of classic ice creams and frozen novelties. Classic ice cream includes special ice cream such as low-fat and non-fat, take home, and bulk ice creams. Frozen novelties include flavored ice, sorbet, and frozen yogurt.[2]

The industry is moderately capital-intensive as large numbers of players are competing with each other to maintain their place in the market. The classic ice cream segment contributed approximately 80% in global retail ice cream industry in 2012, whereas Nestle and Unilever, the two largest players captured one-third of the total market. New product development and innovation plays an important role as a growth driver for industry. Maintaining price and quality, brand loyalty, and consumer group retention are the biggest challenges for industry due to the large number of competitors in the market. (Euromonitor International, 2013). Also in Republic of Macedonia ice-cream industry has a big part of all the economy incomes. In

[2] http://www.idfa.org/resource-center/industry-facts/ice-cream/

Republic of Macedonia there are two big companies that produces ice-cream (classic and novelties of ice-cream), but also there are a lot of retails that sell ice-cream in the territory of Republic of Macedonia. That means that competition is on very high level. In order to be competitive on the market, to get bigger number of customers and to archive bigger profit, ice-cream companies should work regarding proper strategies in order to archive their own goals.

The proper work strategy can be done and helped by knowledge management software application.

With the help of knowledge management software application ice-cream companies can have proper execution of their tasks and can have effective usage of the knowledge they possess.

Knowledge management software application can help ice-cream companies to collect knowledge that they possess, to collect new knowledge, store all the knowledge, then process it, transfer it between all the employees and do update on the knowledge all the time.

On this way ice-cream companies will have proper view of all of their activities, their data, documents, employees' knowledge and they can manage with all of them much easier and faster. Also they can collect and proceed knowledge about their customers, their needs and wishes regarding different types of ice-creams, then knowledge about the market, competition, prices, new technologies for producing ice-cream, new ways of sales etc.

3. PRACTICAL RESEARCH - Cermat Doo – biggest ice-cream company in Republic of Macedonia

The research in this paper is descriptive and it is made by interview with the general manager and owner of the biggest ice-cream company in Macedonia and owner of the other ice-cream distribution companies in Serbia, Montenegro and Croatia.

Cermat Doo is an ice-cream producer company that have the biggest part of Macedonian ice-cream market. Cermat produces different kinds of ice-cream: impulse ice-cream (ice-cream on stick, cornets and ice-cream in cup), family ice-cream and horeka ice-cream (ice-cream for catering).

With all this assortment of ice-cream Cermat satisfy wishes and needs of a lot of customers from Macedonia and other European countries where this company sells: Germany, Austria, Slovenia, Croatia, Serbia, Montenegro, Albania etc.

Not only the rich assortment of ice-cream gives this company competiveness and biggest market share, but also its proper work strategy and its proper use of all the knowledge they possess through knowledge management software application helped this company to be biggest, innovative and advanced ice-cream company in Republic of Macedonia.

Cermat uses knowledge management software application which is created regarding the needs of the company, sectors in the company and needs of the employees.

The name of the knowledge management software application that Cermat use is "CFMA".

This software works with the large databases where are stored all the information and knowledge from the past years and from daily operations. All the stored knowledge go into the company server where they are stored one more time in order to have proper security of all of their knowledge and information.

With the help of this software Cermat has the information of each customer regardless if the customer is small shop, market, supermarket, restaurant, coffee bar etc. Also there are written all the purchases that each customers have done with the exactly articles and time of purchase.

Cermat gives refrigerators with codes to each customer and these codes entered into the database that is connected with the knowledge management software. With the help of this software, Cermat knows where is located each refrigerator that it possess.

Every customer has a different need, wish and opinion regarding the ice-cream quality, ice-cream price, ice-cream size, ice-cream package etc. Cermat on certain time period makes market research in order to collect information of customers on different market regions where it sells in order to discover what customers want and to adjust work strategies and production regarding their needs and wishes. All of this information are stored into the knowledge management software and there are possibilities to be done different analysis and reports. All of these reports and analysis allow Cermat to has a clear view of what kind of ice-cream should produce and sale on different market regions.

Also this software gives Cermat possibilities to make analysis regarding realized sales through the years and to make comparisons regarding the sales year by year.

In the database of this software are also stored information for all suppliers of the company and all the purchases that Cermat have done to them. The software gives opportunity for analysis of prices comparisons of the prices from the suppliers in certain time period.

With this software employees can write and print documents with standard size, look and characteristic which are suitable for the needs of the company.

In CFMA software are stored also all the information of each employee regarding the their education, skills, performance, experience etc. All this information allow managers to know how to allocate human resources to different work positions.

With this software are covered all the aspects of working of this company: sales, financials, human resources, production, customers etc.

4. CONCLUSION

From the theoretical part of this paper can be concluded that knowledge management software applications can help different kind of companies to have view of the knowledge, to work efficient and to reach their goals through proper using of the knowledge that they possess.

Also companies can use all the listed software applications if they are suitable for their needs. If they want, they can order from the software companies software applications that will fit with their needs.

Ice-cream companies also need to use knowledge management software application in order to produce ice-creams regarding the needs and wishes of the customers, to reach bigger market share, to have bigger profit and to adjust all the work process regarding the needs of the company and employees.

With the example of the biggest ice-cream company in Republic of Macedonia it can be seen that all the work process and activities are completely covered by knowledge management software application. All work tasks are very good organized which allows this company to have overview of all the situation on the market, on wishes of the customers, orders, documents, information, tasks, employees etc.

Cermat company should be sample for successful ice-cream producer company that use knowledge management software for all its work activities and tasks. All ice-cream companies should use this kind of software application if they want to be advanced, innovative and successful.

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MEASURING IMPLICIT AND EXPLICIT KNOWLEDGE IN ORGANISATIONS

Ivan Vukić,[1] Mladen Čudanov,[2] Gheorghe Săvoiu[3]
[1]University Pierre et Marie Curie, vukicivan@yahoo.com
[2]University of Belgrade, Faculty of Organizational Sciences, mladenc@fon.bg.ac.rs
[3]University of Pitesti, gsavoiu@yahoo.com

Abstract: *This paper provides review of different approaches to measuring implicit and explicit knowledge in organizations. Based on review of existing literature, we combine theoretic view on measuring and variation with practical measurements suggested by other authors. We analyze the possibility of measuring such implicit and sometimes elusive organizational phenomenon as knowledge. Further we synthesize knowledge measuring methods and measurement units. Next, a set of knowledge indicators used in literature and practice for measuring organizational knowledge is presented.*

Keywords*: Knowledge, Measuring, Knowledge management, Learning organization.*

1. INTRODUCTION

Despite the attempts, there is still no consensus within the academics about definition of knowledge. Western epistemologists often start with Theaetetus, where Plato (2013) discusses "true belief with an account" as the closest acceptable definition of knowledge. Johannessen, Olaisen and Olsen (2001) define knowledge as "systematized and structured information of specific purpose". Dixon (2000) says that "Knowledge stands for important links between the information, that people make in their minds, and application of those links as actions in specific contexts". Suknović and Delibašić (2010) define knowledge as concept which "represents triplet of problem, context and solution". Authors offer the following definition of knowledge: "Knowledge is the system of patterns for information processing, which suggest a solution of a problem in particular context." Therefore, knowledge is defined by three components (Suknović (2010) p. 192, modified): ***context*** (current and desired state), ***problem*** (gap between current and desired state) and ***solution*** (selection of one of the possible ways of achieving the desired state from the current state).

The existence of the system of knowledge is based on several basic assumptions: 1) ***Absolute truth.*** There exists objective truth, which is the convergence of subjective perceptions of reality. (Borgatti and Carboni, 2007), 2) ***Encoded***. People represent the information and knowledge through various processes of encoding, therefore these structures are represented by the system of symbols enforced with particular meaning (Kanwar, Olson and Sims (1981) p. 122-127, modified), 3) ***Understanding***. People can understand the encoded knowledge and information (Reich, 1994), 4) ***Stored***. Knowledge is stored in the memory of the individual in more or less organized (structured) way and makes the network of more or less related concepts (Kanwar, Olson and Sims (1981) p. 122-127, modified), 5) ***Accessible*** (concept or set of concepts may be retreived from the memory as a result of attention focused on the external or internal impulses) (Kanwar, Olson and Sims (1981) p. 122-127, modified).

2. FEATURES OF THE SYSTEM OF KNOWLEDGE

By the term "desirable characteristics" this paper will involve features that it is good that a system has. Well structured knowledge is characterized by the following features: (features 1, 2 and 3: Rief (1984); Elio&Schaf (1990); De Jong and Ferguson-Hesstler (1995) p. 105-113), (features 4, 5 i 6: (Reich, 1994)): 1) ***Durability***. (continuance of acquired knowledge through time), 2) ***Accessibility***. (quick and efficient searching and knowledge finding process), 3) ***Modularity*** (easily adding new elements of knowledge without having to change the existing knowledge structure), 4) ***Transferability***. (knowledge can be shared between systems or reasoning mechanisms), 5) ***Cumulativity*** (knowledge of two quantities can be added to make the third greater), 6) ***Measurabilty*** (that is, it can be measured directly, by direct counting of the elements of structure).

Poorly structured knowledge can be characterized by the following features (according to: Possible anomalies of model and according to: Structural faults of system of knowledge (Ramaswamy, Sarkar and Chen (1997), Yang, Tsai and Chen (2003)): 1) ***Incompleteness***. Knowledge system does not contain all the

parameters (situations) that may occur or do not cover the whole set of possible solutions (Cheng and Huang, 2009). 2) ***Inconsistency***. Knowledge system contains a number of rules, which when applied lead to mutually contradictory consequences. These errors are difficult to identify in large knowledge bases. For details of the measurement and treatment of conflict if-then rules, see: (Cheng and Huang, 2009). 3) ***Ambiguity***. Within the knowledge system two or more actions should be applied, while their order is not defined. 4) ***Inaccuracy***. Model in the knowledge system does not match the real system, therfore the rules applied do not lead to correct conclusions. 5) ***Circularity***. Applied set of rules leads to the reuse of one of the rules in the sequence and creates a circle that has no beginning and no end, and from which it is not possible to get out using the rules in the knowledge base. 6) ***Redundancy***. The case when two or more rules lead to the same conclusion. By eliminating one of these redundant rules knowledge system would still be able to solve the problems. Redundancy usually occurs when different rules lead to a conclusion through a different number of intermediate results.

4. SPECIFICITY OF APPROACH TO MEASURING KNOWLEDGE AND ITS VARIATION

Measure is the homomorphic model (Reich, 1994), which in a formal manner expresses specified property of the real system. It carries information of a specific feature of the system, i.e. information about the quantity of the particular quality, while neglecting all other qualities. Measures have three important roles: 1) ***Informing***. Measures are the carriers of information, which are thus more accurate and complete. 2) ***Comparability***. Measures allow comparison of different systems on the observed features. They are a standard of comparison - etalon. 3) ***Integration***. As a medium of communication between people, the measure has a large effect on strengthening the integration between them, because, lowering transaction costs, facilitates communication and cooperation. Indead, the development of civilizations followed the development of the measurement system.

As the measure is a model of the real system, its quality is basically expressed as the quality of any other model. The following are the basic features that determine the quality of the model. (Radenković, Stanojevic, Markovic (2004), Culligan (2004), Kerzner (2009)): 1) ***Relevancy***. Contextual compatibility of measure, that is: relevance of the information carried by the measured values. We need to make sure that the measurement instrument actually measures what we want to measure. 2) ***Accuracy***. The degree of vicinity of the measured value to the actual value. How the measured value is close to the actual value after measuring. 3) ***Precision***. The consistency of the results over time, in the situations with the same circumstances; That is: the degree to which repeated measurings under the same conditions, give the same result. 4) ***Sensitivity***. If specific feature is measured, what is the probability that the system actually has this feature. 5) ***Specificity***. If the absence of some feature is measured, what is the probability that the system really does not have that feature. 6) ***Cost of measurements***. The total cost of the measurement process (in cash). 7) ***Measuring speed***. The time during which measuring can be performed. 8) The measure is ***valid*** if it is *accurate* and *precise* (Culligan, 2004). It follows that the test cannot be more than what is valid reliable, ie. reliability is the upper limit of validity .

First of all, anyone must measure in a scientific way, to find the variation limits, in any type of scientific knowledge and knowledge management. Appearing in philosophy as an antithesis to Socratic identity, *variation* is the natural consequence of the impossibility of there being several identical things: “How can several objects be identical if there are more of them?” An answer formulated in a purely philosophical spirit becomes the most pragmatic vision of variation: “They are not identical. I need to distinguish them by something. If they did not differ, we would not be able to perceive them as such” (Ionescu, 1993). Such multidimensional and implicit phenomenon as knowledge is very hard to be abstracted toward comparison among different instances. Identity, formulated by Socrates “ab initio” as an intrinsic quality of the object, evolves towards defining through comparing and relating, and generates the *stationary* or the “premise of variation”. Plato placed variation within two of the five universal concepts applicable to all things, viz. *difference* and *change*, which followed *existence* and *identity*, yet before *resistance*. The paradoxes of ancient Greece, generated by the absolutely special depth of ancient Greek thought, provided the essential delimitations between variable and constant, dynamic and stationary. Zeno’s arrow paradox can be answered, after nearly two and a half millennia, by modern statistical physics, through describing the opposition between wave and particle, since *what is in a point cannot be moving or evolving, and what is moving and evolving can be found at no point*, as the memorable formulation of Louis de Broglie runs (1966). The development of logic, along with the use of mathematical induction, had the final premise of *apparently limiting independent variation*. The very “aletheia”, or the visible truth of classical Hellenic logic, has the two faces of Janus and expresses *spatial and temporal variability*.

Identity in itself contains its opposite, in the concept of difference (variation)*, in the inimitable Hegelian spirit*. The logic of falseness and truth is transformed, by the paradigm of variation, into a simple *alternative type variable* (F/T). In Stefan Odobleja's philosophical thought (1938), against the backdrop of the logic of the apparent or related variables, as well as that of real or free variables, the "variability of species and natural selection" develops resonantly. Even Darwinism finds that variations occur without apparent cause, spontaneously, and distinguish three major types: a) defined variations, which occur when all or nearly all the offspring of individuals, subject to the influence of certain conditions for several generations, change in the same manner; b) undefined variations or changes, which occur in some individuals of a population and "can be regarded as indefinite effects of the conditions of life" (while effects appear as random in relation to the conditions, undefined variations are either useful, or indifferent, or even harmful); c) correlative variations, which are the result of the logic of the correlation between organs (causing virtually the modification of an organ in a certain way, and entail the modification of the organ it is correlated with).
Phenotypic variation, seen as the totality of all biological variations (Vp), is the sum of two components of the aggregate type, namely the variation caused by the influence of environmental factors (Ve, or the "environmental variation" component), and the variation caused by the contribution of segregating genes (Vg, or the "genetic variation" component):

Vp = Ve + Vg < – resonant or interfered – > $(\sigma_g^2)=(\sigma^2)+(\sigma^2)$ (1)

Similarity with the statistical rule of adding explained variance (the mean value of group dispersions) to residual dispersion (the average of group dispersions), the resulting amount being nothing else than the dispersion of the population or general community, confirms the existence of the *paradigm of variation* as *isomorphism*, the computing relations being resonant with the rule of adding dispersions, they finally indicate the calculation formula for the coefficient of determination (Săvoiu, 2009).
Heritability or the proportion of the total variation that is controlled by heredity ($H = h^2$) is a relation between the variation determined by multiple genes with additive effects (V_a) and phenotypic variation (V_p):

$$H = h^2 = \frac{V_a}{V_p} \text{ or } H = h^2 = \frac{V_a}{V_e + V_g} \quad (2)$$

hence:

$$h = \sqrt{\frac{V_a}{V_p}} = \sqrt{\frac{V_a}{V_e+V_g}} \text{ <- resonant or interfered – > } R = \sqrt{\frac{(\delta^2)}{(\sigma_0^2)}} = \sqrt{\frac{(\delta^2)}{(\delta^2)+(\sigma^2)}} \quad (3)$$

The two essential Darwinian categories, heredity, as a property of living beings to develop *the same* characters, and variability, i.e. the permanent emergence of *differences* between the individuals of the same species, are the support of evolution by selection (in the sense of transformation of species), and, englobed in a much more general biological notion, they represent the support of speciation (the emergence of new species from old ones, or the evolutionary development of a biological species, as by geographical isolation of a group of individuals from the main stock). Teleonomy has currently become the science of researching living organisms, due to their specific features, which include causality, finality, and especially due to their development towards higher *differentiated, functionally superior structures* (teleonomic capacity). The temptation of *lex*ification of biology, in the scientific manner of thinking (Săvoiu and Iorga Simăn, 2012), focused on the *paradigm of variation* in biology, is resonant with the scientific fields of logic and mathematics (as vague final influences of thermodynamics):
Prima regula: Variation (variability) does not exist alone, but it co-exists in a balanced manner along with stability (heredity).
Secunda regula: The total variation is the sum of two components, bringing together key / essential factors, which are explanatory and nonessential or residual.
Tertia regula: The proportion of the total variation, which is *controlled* by a key factor, is a determinable ratio.
Quarta regula: The various partial variations are correlative, and one can determine the existence, the direction and the intensity of the relationship between the partial variations in the total variation.
Quinta regula: Evolutionary processes contain both correlative and non-correlative variations, and, in so far as the system in which they occur is temporarily closed or static and there is a universal unit of measurement, the total sum of the variations becomes relatively constant, and the regressive evolution is irreversible (entropic). A final remark to the variation paradigm, as applied to social and natural sciences and scientific knowledge, is that biological variation can be considered the fundamental factor in the process of evolution, including knowledge and knowledge management evolution.

One of the main characteristics of knowledge that causes a specific approach to its measurement is the inability of measuring knowledge directly. In contrast to physical measurements, where certain features of the object can be measured directly (for example, length), knowledge measurement in most cases can not be performed directly (Kyburg, 1984). Therefore specific approaches need to be developed. In the first

category of approaches, knowledge is viewed in a static way, while in the second in a dynamic way. In the static perspective structural measures of knowledge are used, and in the dynamic perspective functional measures of knowledge are used. ***Structural measures*** include, for example, the number of models either in textbooks, computer programs, the college courses etc. Disadvantages of static perspective are as follows (Vukić, 2012): 1) The uncertainty in the prediction , 2) Separation from the experience, 3) Externalisation. On the other hand, the ***Functional measures*** include the Performance Measurement. The basic idea of performance measurment system has been expressed by modified composite score model, consisting of the following elements: time, resources, information, quality, quantity, performance and knowledge. Fixing of the five elements and measuring sixth, the seventh element (which in this case is knowledge) can be indirectly measured. For example, fixing the information, resources, time, effects and quality, reached quantity points to level of knowledge. In second case: fixing the quantity, quality, effects, time and resources, the amount of required information needed indicates the level of knowledge. By performing the analysis of the current practices in knowledge measuring methods, classification given in the following table can be made (Vukić, 2012):

Table 1: Knowledge measuring methods and measurement units

	Category	Subcategories	Examples	Possible unit
A	**SIMULATION**	***Readings***. ***Listening***. ***Training***.	*-Read literature-* -Lectures/Talks attended- -Computer simulation*, Real simulation-*	*-Number of characters-* -Number of hours- -Number of hours-
B	**EXPERIENCE** Implicit knowledge	***Cycluses***. ***Events***. ***Outputs***.	*-Project realized, Repeated activities-* *-Events/Situations carried out-* *-Generated outputs-*	*-Number of repeated cycluses, of standardized size/complexity-* *-Number of elementary events-* *-Number of generated outputs, of standardized complexity-*
C	**AKADEMISM** Explicit knowledge	***Patents***. ***Publications***. ***Speeches***.	-Papers*, Models, Tables, Formulas, Code, Patents-* *-Articles, Books-* *-Presentations, Talks-*	-Number of standardized papers, models etc- *-Number of characters-* *-Number of hours -*
D	**RECOGNITION** & RANKING	***Test***. ***Tournament***. ***Assessment***.	*-Questions, Assignments-* *-Competitions-* *-Performances, Interview-*	*-Number of standardized score points-* *-Number of standardized score points-* *- Number of standardized score points -*

Current challenges in measuring knowledge are numerous. Literature and research in this area is so fragmented that there is no widely accepted model or theory. (Fisher and White, 2000) . Therefore, humanity is limited to the lack of an integrated approach to the knowledge measuring (Boudreau, 2002). The following challenges in measuring knowledge had been identified (Reich, 1994) 1) ***Confusion***. Dispersion in understanding the concept and defining the term “knowledge”. 2) ***Chaotic state of measures***. Chaotic state of dimensions and indexes of knowledge, with the complete absence of system of them. 3) ***Nonmodularity of knowledge***. Inability to observe large blocks of knowledge as the sum of fundamental (unit) elements without significant loss of information. This is particularly true for the knowledge measuring, because the important feature of knowledge is a huge number of potential connections between those elements. Therefore, the binary operations are here critical and must be taken into consideration when establishing measures, and their preservation is essential to the validity of the measure. Therefore, a valid measure must guarantee preservation of binary operations (that is connections) of the real system. 4) ***Operationalization***. It is interesting to notice that there is a lot of attempts for conceptualization of cognitive structures, but very few attempts for their operationalization, that is practical application. Hardly anyone has attempted to directly measure those cognitive structures. (Kanwar, Sims and Olson (1981), and Borgatta Carboni (2007)).

5. KNOWLEDGE INDICATORS

Knowledge indicators (indexes) are measures that indirectly point certain *dimensions of knowledge* (Vukić, 2012). According to the authors, it is important to distinguish between the two. While on the one hand, the dimensions are describing certain features of the knowledge system (and they are permanent), on the other

hand indicators point to one or more of these dimensions (moreover indicators may change as better are adopted). The following are indicators proposed by different authors:

Bodreau (2002) had classified indicators of knowledge into three categories: indicators that indicate the knowledge stocks, indicators that indicate the knowledge flow and indications of knowledge enablers.

A) ***Knowledge stock*** refers to the current level of knowledge in the observed time. Next set of index should indicate the level of knowledge in the system at a given time: 1) *Accounting for Intangibles* (Nick Bontis, 2001). Knowledge assets are blocks of knowledge that are expected to generate added value for the company in a period of time that is difficult to predict (Boisot 1998). 2) *Financial Statement Augmentation* (Intellectual capital report). This report is neither standardized nor obligatory and what it will include varies from organization to organization. 3) *Patents, Publications, Citations*. Patents and publications are the product of knowledge while number of citations indicates the quality of knowledge. Spencer (2000) examined archival data on issued articles within the Japanese and U.S. companies. He was measuring the volume (number of articles), quality (number of citations from outside the organization) and breadth (number of different organizations whose scientists have cited the work). 4) *Education and Training*. Number of hours dedicated to education and training and assessment scores. 5) *Organizational Experience and Rivalry Patterns*. Experience includes the amount of output the system produced or time spent in producing particular type of product. According to this idea, the more time the system spends generating output, the more knowledge about it system has, as a consequence of selicting those decisions over time that give better effects. Experience is also measured according to the degree of exposure to competition and the degree of rivalry - competitive experience (Ingram and Braum, 1997). 6) L*earning curve* indicates the experience and thus the knowledge, by showing the dynamics of declining of product unit cost. Decline in unit cost comes with experience in the respective manufacturing process. 7) *Team performance* indicator is used to measure the knowledge of a team. Team performance is measured as a percentage of accomplishment of the mission, that is the proportion of tasks completed successfully and the total number of tasks. Another way to measure performance is to measure the time it takes to perform the mission and to devide that number with planned time. The third way is to calculate the number of tasks that are executed per minute. (Cooke, Preston, Kiekel, Salas and Stout, 2003).

B) ***Knowledge flow*** can be measured as the difference between two consecutive levels of knowledge (that are measured by previously defined indexes). 1) *The knowledge flow between individuals*: a) The degree to which individuals share information with each other - Does the staff provide information to their colleagues? b) The convergence of attitudes and perceptions (beliefs and mental models) is also one of the indicators of knowledge transfer among individuals. c) Degree of standardization - Consistency of terminology and formal models indicates transfer of knowledge. 2) The knowledge flow among teams: a) Change the observed performance of the team. b) Formal transfer of technology: procedures, techniques, tools, patents. 3) *Knowledge spillovers and the loss of knowledge in the system*: a) Number of patents and citations that took the competition. (Jaffe, Trajtenberg and Fogarty, 2001). b) Staff turnover ratio - In particular, key managers and professionals. (Deeds, 2003).

C) ***Enablers*** are the structures and processes established by the organization, which aim to change or maintain knowledge stocks or knowledge flows. Enablers facilitate changes in the knowledge levels. These include social networking, organizational structure, transactional memory, procedures, etc. However the very fact that they are present does not mean that their features are used and that the knowledge has been generated or modified. Therefore, this group of indexes only carries additional information about the potential and not the actual events in the system of knowledge. 1) *Geographical, Character, Political vicinity*. Several authors have studied the physical, character and political (attitudes, beliefs) vicinity (Maskell&Malmberg, Torstensson, Capello, Zahra) and concluded that those parameters have a positive impact on knowledge transfer. (Bordeau 2002). 2) *Organizational structure*. The organizational factors that can encourage or discourage the acquisition and use of knowledge are formalization, centralization, specialization, incentives, emphasis on scientific research and publications in the company etc. For example, high interdependence (specialization) requires a lot of contacts, which allows preconditions for an exchange of diverse knowledge. 3) *The number of joint ventures with other systems*. This indicator follows the next idea: The greater the number of joint ventures, the greater the chances of raising the level of knowledge. These include: alliance, joint ventures, franchises and the like. 4) *The costs of R&D* indicate how the organization deals with the generation of new knowledge that is innovation in a systematic way. (For more details see: Bitzer, 2005) 5) *Aquisition Capacity* stands for the capacity of a system to adopt new knowledge. 6) *Network*. The characteristics of the network within the system (individual or organizational network) are to be observed - The following network characteristics are important: Size, Scope (the contacts in different categories), Strength, Intensity (frequency, duration and intensity of interactions), Structure, Communication, Individual movement. 7) The degree of trust. The greater degree of trust between people is, the more open for learning system will be (Fiol, 1985). 8) *Tacitness*. (1/ knowledge formalisation that is 1/degree of knowledge formalisation). Tacitness indicates

the ease of knowledge transfer. The greater the degree of formalisation is, the transfer of knowledge is done with fewer losses and thus the potential spread of knowledge is greater. This is neither good nor bad by itself (tacitness is harmful in the context of cooperation, but it is useful in rivalry and competition context since it makes the knowledge copying process more difficult.

ICM group had classified the knowledge indicators in 5 categories: Customer capital, Structural capital, Human capital, Value creation and Value extraction. (Liebowitz and Suen, 2000)

Customer capital : 1) Market share, 2) Customer rating, 3) Satisfied customer index, 4) Number of new customers, 3) Annual sales/Customer, 4) Average customer size, 5) Average time from customer contact to sales response, 6) Ratio of sales contact to sales closed.

Structural capital. 1) Administrative expence/Total revenues, 2) Processing time, outpayments, 3) Computers/Employee, 4) Corporate quality performance, 5) Investments in IT, 6) Contracts filed without error.

Human capital. 1) Number of employees, 2) Number of managers, 3) Average years of service with the company, 4) Revenues/Employee, 5) Profits/Employee, 6) Employee turnover, 7) Average age of employees, 8) Percentage of company managers with advanced degrees

Value creation. 1) Training expence/Employee, 2) Average customer duration with the company, 3) R&D invested in the basic research, 4) R&D invested in product design, 5) R&D invested in applications, 6) Investment in new product support and training, 7) Satisfied employee index, 8) Relationship investment/Customer, 9) Training expence/Administrative expence.

Value extraction. 1) Profits resulting from new business operations, 2) Revenues resulting from new business operations, 3) RONA resulting from new business operations, 4) Total assets, 5) Return on net assets, RONA, 6) Market value, 7) Patents pending

Roos, Roos, Dragonetti, Edvinsson (1998) classify knowledge indicators into two categories: Human capital and Structural capital, which is also described by Liebowitz and Suen (2000):

Human capital. 1) Percentage of employees with advanced degrees, 2) IT literacy, 3) Hours of training/Employee, 4) Average duration of employment, 5) Hours spent in debriefing, 6) Hours spent by senior staff explaining strategy and actions – overlap expertise, 7) Leadership index, 8) Motivation index, 9) Savings from implemented employee suggestions, 10) New solutions or products or processes suggested, 11) Background variability index (both on individual and group level), 12) Company diversification index.

Structural capital. 1) Percentage of supplier/customer business accounted for, 2) Length of relationship, 3) Partner satisfaction index, 4) Customer retention, 5) Administrative expences/Total revenues, 6) Revenues from patents, software, data, databases, 7) Processes completed without error, 8) Cycle/process times, 9) Training Expenses/Employee, 10) Training Hours/Employee, 11) New patents, software etc, 12) Renewal expenses/Operating expenses.

Canadian Management Accountants (CMA) stated the following list of knowledge indicators in the organisations: 1) Number of new products, 2) Number of new customers, 3) Success ratio, 4) Percentage of customer business, 5) Productivity index, 6) Number of processes reviewed, 7) Number of processes changed, 8) Percentage rated acceptable at first review, 9) Numbers of patent filed, 10) Number of ideas implemented from the suggestion box, 11) Ratio of temporary/total employment, 12) Traditional quality indicators, 13) ISO and customer satisfaction. (Liebowitz and Suen, 2000). **Leif Edvinsson i Michael Malone** The two authors offered a set of indicators in a report on intellectual capital (Universal Intellectual Capital Report). Indicators are classified in five categories: Financial focus, Customer focus, Process focus, Renewal and development focus, Human focus. (Liebowitz and Suen, 2000)

Jay Liebowitz i Ching Suen (2000) sugested several new indicators as as a complement to the ones previously mentioned: 1) Number of new collegue to collegue relationships spawned, 2) Reuse rate of freequently accessed-reused knowledge, 3) Dissemination of knowledge sharing (distribution of knowledge to apropriate individuals), 4) Level of knowledge sharing profficiency, 5) Interactions with academicans, consultants and advisors, 6) Number of apprentances that one mentors in the company, and the sucsess of the apprentances, 7) Number of patents/trademarks produced, Number of articles/books written, Number of talks/workshops given, 8) Number of lessions learned and best practices applied, 9) The number of new ideas gennerating new products or services.

6. CONCLUSION

The main advantage of the indicators is that they can be easily obtained. Most of them are already available because of their wide use for other purposes. The main limitation of these indicators is their stochastic nature. They do not measure the dimensions of the knowledge directly, instead they only can (but need not)

to point some of them (Liebowitz and Suen, 2000). This brings a significant amount of uncertainty in decision making based on knowledge indicators. Moreover, some indicators have narrow scope of application, that is, they are constrained to certain industries. Examples which may be mentioned are numerous, and the following is to name a few: 1) Patents and citations are not applicable in most industries . Their absence does not mean lack of knowledge. 2) R&D investments are reflecting the invesments into knowledge but not the knowledge itself. As the generation and accumulation of knowledge depends on the process of acquisition (it is highly “path – dependent”) this characteristic makes it almost impossible for precise approximation with this indicator (Bettis and Hitt, 1995). 3) Intellectual capital, which is calculated as the difference between market value and book value (Edvinsson , Malone, Sveiby) cannot be a valid indicator of knowledge. Otherwise, the intellectual capital could be expressed as a mathematical function of accounting methods. Detailed review is presented in the Larsen, Bukh and Mouritsen, 1999). Therefore, humanity is in the initial stages of establishing a system that will successfully measure their knowledge . This "young" system of measures, naturally, is not sufficiently integrated nor consistent. However, current measures, although insufficiently integrated and therefore suboptimal, are a good starting point for both operational measurement of knowledge, and for the further development of measures.

Further work of standardizing units of measure for different listed indicators, as well as integrating indicators and model them as regressional models (or other statistical models), proposing their contribution to the features of knowledge is to be taken.

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